CAEDYM: Computational Aquatic Ecosystem Dynamics Model

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Download Information

Availability: Nonproprietary
www.cwr.uwa.edu.au/~ttfadmin/model/caedym
Cost: N/A

Model Overview/Abstract

The Computational Aquatic Ecosystem Dynamics Model (CAEDYM) is a comprehensive aquatic ecological model that is based on the nutrient-phytoplankton-zooplankton food chain relationship. The state variables of CAEDYM include carbon, oxygen, silica, inorganic particulate, and other biological factors. CAEDYM can be linked with several hydrodynamic models, such as DYRESM and ELCOM, to describe one-, two-, and three-dimensional processes of primary production, secondary production, nutrient and metal cycling, and oxygen dynamics and the movement of sediment.

Model Features

- Phytoplankton: up to seven groups
- Dissolved oxygen, biochemical oxygen demand ("fast" and "slow")
- Nutrients (NH_4, NO_3, PO_4, TP, TN and internal phytoplankton N, P and C)
- Suspended solids: two groups
- Zooplankton: up to five groups
- Fish: up to nine groups including jellyfish and seagrasses/macrophytes
- Macroalgae
- Macroinvertebrates (bivalves, polychaetes and crustacean grazers)
- pH
- Metals: iron, manganese and aluminum

Model Areas Supported

Watershed	None
Receiving Water	Medium
Ecological	High
Air	None
Groundwater	None

Model Capabilities

Conceptual Basis
The waterbody is conceptualized as a network of grid points (finite difference).

Scientific Detail
CAEDYM is a detailed aquatic ecological model that simulates the nutrients, phytoplankton, zooplankton, fish, and benthic habitat. The model requires external hydrodynamic models to provide temperature, salinity, and transport driving forces. CAEDYM usually runs at the same timestep as the hydrodynamic models. The state variables include dissolved oxygen, inorganic nutrients, dissolved organic nutrients, particulate organic nutrients, and inorganic suspended solids in both the water column and sediment layer. The water column variables also include pH, color, one group of bacteria, seven groups of algae, five groups of zooplankton, one group of jellyfish, five groups of fish, one group of pathogen, four groups of macroalgae, one group of seagrass, and three groups of invertebrates.

Model Framework
- One-dimensional vertical
- One-dimensional longitudinal
- Two-dimensional longitudinal-vertical
- Three-dimensional
- Reservoir, lake, estuary, river, floodplain

Scale

Spatial Scale
- One-, two-, or three-dimensional

Temporal Scale
- User-defined timestep

Assumptions
Aquatic ecological dynamics can be described with the ordinary differential equations.

Model Strengths
- Detailed aquatic ecology, strong ecological modeling capability
- Flexible structure

Model Limitations
- No sediment diagenesis

Application History
CAEDYM is used in 59 countries around the world.

Model Evaluation
Not available

Model Inputs
- Initial concentrations of state variables

- Inflows and concentrations in inflows and over forcing regions
- Parameter values
- Other data may be required by the hydrodynamic driver (DYRESM or ELCOM), e.g., meteorological forcing data

Users' Guide

Computational Aquatic Ecosystem Dynamics Model CAEDYM v2.1 Science Manual
Computational Aquatic Ecosystem Dynamics Model CAEDYM v2.1 User Manual
Available online: http://www.cwr.uwa.edu.au/~ttfadmin/model/caedym/

Technical Hardware/Software Requirements

Computer hardware:

- PC

Operating system:

- Windows 95/98/NT, Linux, DEC Unix

Programming language:

- FORTRAN 95

Runtime estimates:

- Minutes to hours

Linkages Supported

CAEDYM can be linked with the following hydrodynamic models:

- DYRESM (one-dimensional vertical for deep lakes and reservoirs)
- DYRISM (Quasi-two-dimensional Lagrangian for rivers and floodplains)
- ELCOM-2D (two-dimensional laterally averaged for narrow lakes and reservoirs)
- ELCOM (three-dimensional for any waterbody)

Related Systems

CE-QUAL-R1, EFDC, CE-QUAL-ICM, WASP/EUTRO, CE-QUAL-RIV1, CE-QUAL-W2

Sensitivity/Uncertainty/Calibration

Not available

Model Interface Capabilities

- Graphic Interface written with Java

References

Hipsey, M.R., J.R. Romero, J.P. Antenucci, and D.P. Hamilton. 2004. *Computational Aquatic Ecosystem Dynamics Model CAEDYM v2*. (Computer program manual). Centre for Water Research, The University of Western Australia.

Romero, J.R., M.R. Hipsey, J.P. Antenucci, and D.P. Hamilton. 2004. *Computational Aquatic Ecosystem Dynamics Model CAEDYM v2.1*. (Science manual). Centre for Water Research, The University of Western Australia